Welcome to Physics 1180

(Physics in the Modern Era)

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Topics for Today

- Units,
- Conversions
  - Conversion Factors
  - Multi-step conversions
  - Conversions with Exponents
- Significant Digits
- Scientific Notation
- Ratio Method

Units

Suppose you asked, “How fast is that river flowing?” and you were given the answer, “25.”

What would you reply?

“25… what?”

Unit conversions

Not everyone uses the same units. So, you must be able to convert from one system to another.

Questions: What happens when you multiply any quantity by “1”?

Nothing!

Anytime you do a conversion you do not change the quantity. Rather, you merely change the way it is measured.

Unit Conversions

To convert between (say) hours and seconds we start with the relationship that

$$1\ \text{hr} = 3600\ \text{s}$$

Then dividing both side by “1 hr” gives:

$$\frac{1\ \text{hr}}{1\ \text{hr}} = 1 = \frac{3600\ \text{s}}{1\ \text{hr}}$$

Of course we could have divided both side by “3600 s”:

$$\frac{1\ \text{hr}}{3600\ \text{s}} = \frac{3600\ \text{s}}{3600\ \text{s}} = 1$$

Unit Conversions

Which conversion factor you use depends in which way you want to go. To convert from "hours" to "seconds," multiply the "# hours" by $(\frac{3600\ \text{s}}{1\ \text{hr}})$.

Example: 4 hr = (4 hr)(1) = (4 hr)$(\frac{3600\ \text{s}}{1\ \text{hr}})$ = 14400 s.

To convert from "seconds" to "hours," multiply the "# s" by $(\frac{1\ \text{hr}}{3600\ \text{s}})$.

Example: 2700 s = (2700 s)(1) = (2700 s)$(\frac{1\ \text{hr}}{3600\ \text{s}})$ = 0.75 hr

That is, choose the conversion factor that will cancel the units that you don't want, thus leaving the unit that you do want.

Significant Digits

- All nonzero digits are significant.
- Zeros between nonzero digits are significant.
- Zeros to the left of the first nonzero digit are not significant.
- Zeros at the end of a number that are to the right of the decimal point are significant.
- Zeros at the end of a number that are to the left of the decimal point may or may not be significant.

Arithmetic Operations

- Multiplication & Division:

  Final answer should have the same number of significant figures as the measurement with the fewest number of sig figs.

- Addition & Subtraction:

  Final answer should have the same number of decimal places as the measurement with the least number of decimal places.

DO NOT CONFUSE "SIG FIGS" WITH DECIMAL PLACES!!

Example #1

A rectangle is measured to have a length of 10.3 cm and a width of 7.2 cm. Calculate the area of the rectangle to the proper number of sig figs.

A) 74 cm^2

B) 74.1 cm^2

C) 74.16 cm^2

D) 74.2 cm^2

E) None of the above.

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Example #2

Find the sum of

5.1 + 18.563 + 0.07

to the proper number of sig figs.

A) 23

B) 23.7

C) 23.73

D) 23.733

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Example #3

Which of the following measurement (if any) have 3 sig figs?

A) 4.27 m

B) 42.7 kg

C) 0.00427 LY

D) All of the above.

E) None of the above.

Example #3

Which of the following measurement (if any) have 3 sig figs?

A) 4.27 m

B) 427 kg

C) 0.00427 LY

D) All of the above.

E) None of the above.

Scientific Notation

To express very large and very small numbers, we we use (normalized) scientific notation. For example:

The speed of light is (about) 300000000 m/s.

The radius of a hydrogen atom is 0.000000000529 m.

To avoid dealing with all those zeroes, these same numbers are expressed as:

The speed of light = 3.00×10^{8} m/s.

The radius of a hydrogen atom is 5.29×10^{-11} m.

Normalized Scientific Notation & Significant Digits

There are many ways if written a number could be written using "power of ten" (a.k.a., scientific notation).

For example, here are three of many possible ways to express the speed of light:

300×10^6 m/s or 30×10^7 m/s or 3.00×10^8 m/s

While all of these are technically written in scientific notation, only the third case in written in normalized scientific notation. That is, the first nonzero digit in the only digit to the left of the decimal point.

Furthermore, the third case also makes it clear that there are three significant figures in the measurement, while the other two ways a vague. (Why?)